

the iron is incorrect, but that at any rate, most, if not the whole, of it is as two or more definite compounds of iron and chromium diffused through the mass of iron. Different portions of the same pig iron contain variable percentages of these compounds.

The sample of pig iron from which these results were obtained gave 8.98 per cent. of chromium in one part, and 6.63 per cent. in another.

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ART. XIV.—*Formation of Hyalite by the Action of Ammonia.*

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[Read 12th December, 1878.]

IN the examination of building stones used in Melbourne I have noticed that the greatest amount of decay takes place during the summer months, December, January, and February, and that the stones which harden on exposure harden most during those months; also, that taking two portions of the same stone, saturating one part with water, and leaving the other dry, the wet stone hardens first, the hardening taking place from the outside inwards.

Analysis of the outer portions of these hardened stones shows an excess of silica, more or less hydrous, and nearly always giving distinct traces of ammonia.

In the Geological Survey Reports, Nos. 4 and 5, I have called attention to some of these peculiar passages of silica from the inner to the outer parts of the stone, and shown that all our freestones, except those already hardened by exposure, are acted on with considerable rapidity by ammonia and carbonate of ammonia. Some are hardened by this action and some are disintegrated. Those which are destroyed fall gradually away, the cementing material being decomposed by the ammonia, and the quartz grains are left free to fall or be washed away by the rain.

In the stones which are not destroyed but harden, some other action takes place; the cementing material between the sand grains is not softened, but it changes from a dull

opaque or white clayey cement to a vitreous or quartz-like material, eventually, as may be seen on the surface of many of our sandstone ranges, to a dense quartzite.

On the Grampian range, at the Blue range at Mansfield, and at Freestone Creek in Gippsland, the rocks are usually very hard silicious sandstones at the surface, and give when crushed and washed little or no clayey matter; but a few inches, or at most a few feet, from the surface on the same beds the character changes, and on crushing and washing the cementing material may be obtained as a nearly white clayey material like kaolin.

I have to a limited extent succeeded in changing clayey sandstones to hard silicious sandstones by causing them to absorb ammoniacal solutions in such a manner that the liquid was absorbed at one end of the stone and evaporated at the other, and obtained an outer surface hard and silicious like that found in nature.

With stones containing silica in a hydrous form, like the Oamaru, New Zealand, limestone, the passage is most marked. In a few weeks the outer or evaporating surface gave upon analysis twice as much silica as the interior of the stone.

Thus, besides mere transfer of silica, the ammoniacal solutions of silica are capable of producing actual metamorphism, changing the character and structure of the silicate rocks.

Some eighteen months ago I placed some clean infusorial earth from Talbot in a solution of ammonia. The whole of the earth was composed of the transparent forms of diatoms, *i.e.*, nearly pure hydrous silica. Recently examining the contents of the bottle, I find that a portion of the silica has been dissolved in the ammonia, giving a solution containing 77.1 per cent. of silica; at 212 it lost 0.1 per cent., and 0.01 on heating to about 350. The amount of hydrous silica in solution is therefore over 500 grains to the gallon, far in excess of that held in solution in the waters of the hot springs of New Zealand.

The solution of silicate of ammonia may be boiled till all excess of ammonia has been expelled, and according to Pribram (*Watts' Sup.*), 1 equivalent of ammonia is left in solution with 80 of silica.

This boiled solution, in contact with bases, forms crystallisable hydrous silicates. When evaporated to dryness it deposits the silica as a film, which shrinks and cracks as the last of the water is driven off.

In this solution of silica, held in solution by ammonia, which we may obtain from almost any, if not all, of our springs or subterranean waters, we have, no doubt, one of the active agents of metamorphic action. Just above the surface of the liquid on the sides of the vessel I find a botryoidal coating of hydrous silica, in all respects identical with the mineral hyalite.

In this artificial hyalite there are some infusorial forms which have been entrapped. Most of them seem to be partly dissolved; some are mere skeletons of the original form.

In the mineral hyalite from our basaltic formations my assistant, Mr. Dunn, finds distinct traces of ammonia, and as we know ammonia is present in all our subterranean waters, we have a means of accounting for these films or crusts of botryoidal silica, and probably for the veins and masses of chalcedony and opal found in the decomposed volcanic rocks.

A curious change has taken place in the residue of the infusorial earth from which the solution was made. All the forms of diatoms have vanished, and instead I find a fine granular powder. The mass has shrunk considerably, and is covered by a friable film.